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Abstract

The problem of designing a component that combined with a known part of a system,
conforms to a given overall specification arises in several applications ranging from logic
synthesis to the design of discrete controllers. We cast the problem as solving abstract
equations over languages. Language equations can be defined with respect to several
language composition operators such as synchronous composition, •, and parallel
composition, ◊; conformity can be checked by language containment. In this paper we
address parallel language equations. Parallel composition arises in the context of
modeling delay-insensitive processes and their environments. The parallel composition
operator models an exchange protocol by which an input is followed by an output after a
finite exchange of internal signals. It abstracts a system with two components with a
single message in transit, such that at each instance either the components exchange
messages or one of them communicates with its environment, which submits the next
external input to the system only after the system has produced an external output in
response to the previous input. We study the most general solutions of the language
equation $A \diamond X \subseteq C$, and define the language operators needed to express them. Then we
specialize such equations to languages associated with important classes of automata
used for modeling systems, e.g., regular languages and FSM languages. In particular, for
$A \diamond X \subseteq C$, we give algorithms for computing: the largest FSM language solution, the
largest complete solution, and the largest solution whose composition with $A$ yields a
complete FSM language. We solve also FSM equations under bounded parallel
composition. In this paper, we give concrete algorithms for computing such solutions,
and state and prove their correctness.